



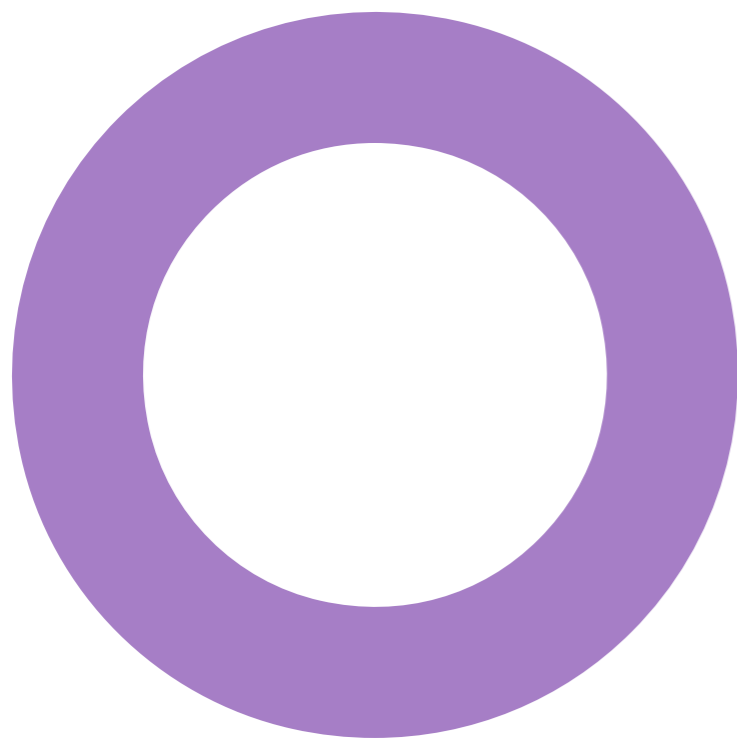
Appendix 3.17

Lighting Impact Assessment - Illumination Impact Profile (IIP)

Barry Biomass. Biomass UK No.2 Limited.

16-17123 LIGHTING IMPACT ASSESSMENT - ILLUMINANCE IMPACT PROFILE
BARRY BIOMASS.
JULY 2022

DOC-16-17123-5A-20220719-SMK-IIP-01



Audit sheet.

Rev	Date	Description	Prepared	Verified	Authorised
01	19/07/2022	First issue.	SMK	DDM	DDM

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1.0 Introduction.

This has been prepared by Hoare Lea to present quantitative information regarding pre and post development illuminance and luminance effects for residential locations.

IIP – Illumination Impact Profile

The following provides an Illumination Impact Profile, in tandem with the Planning Application, which gives assessment of the exterior lighting design proposal's impact on the surrounding Environmental Zone. With the passing into law of the 'Clean Neighbourhood and Environmental Act' 2005 this issue became a major deliverable for exterior lighting projects.

The intention of the Illumination Impact Profile package is to convey how the proposed development will affect the illumination profile of the area and how that will comply with relevant legislation requirements and best practice design guidance.

In accordance with CIE guidance 2003 & 2017 and the ILP Guidance Notes for the Reduction of Obtrusive Light (2021) and in relation to the assessment, the following definitions are used in describing obtrusive lighting effects:

- Direct sky glow: the direct upward spill of light into the sky, which can cause a glowing effect and is often seen above cities when viewed from a dark area.
- Upward reflected light: the reflected upward spill of light into the sky, from surfaces below the light sources. A contributor to sky glow.
- Glare: (viewed source intensity) the uncomfortable brightness of the light source against a dark background which results in dazzling the observer, which may cause nuisance to residents and a hazard to road users.
- Light spill: the spilling of light beyond the boundary of the area being lit.
- Light intrusion: nuisance light, levels of light above defined values into residential properties.

Completed Development Lighting Parameters

This report is to be viewed in conjunction with partnering reports and drawings; DOC-16-17123-5A-20220314-RJM-BB-BLS-01 which provides an assessment of the current base line lighting for the area surrounding the development. The drawing DBB-HLEA-XX-00-DR-E-708001 GRD Ext Lighting Parameter Plan - P02 provides details regarding fitting types and recommended lighting levels of illumination. The drawing BB-HLEA-XX-00-DR-E-708001 GRD Ext Lighting Design Plan P02 provides a detailed plan of location of luminaires along with a schedule. These reports inform the modelling of the site and likely impact on the surrounding environment.

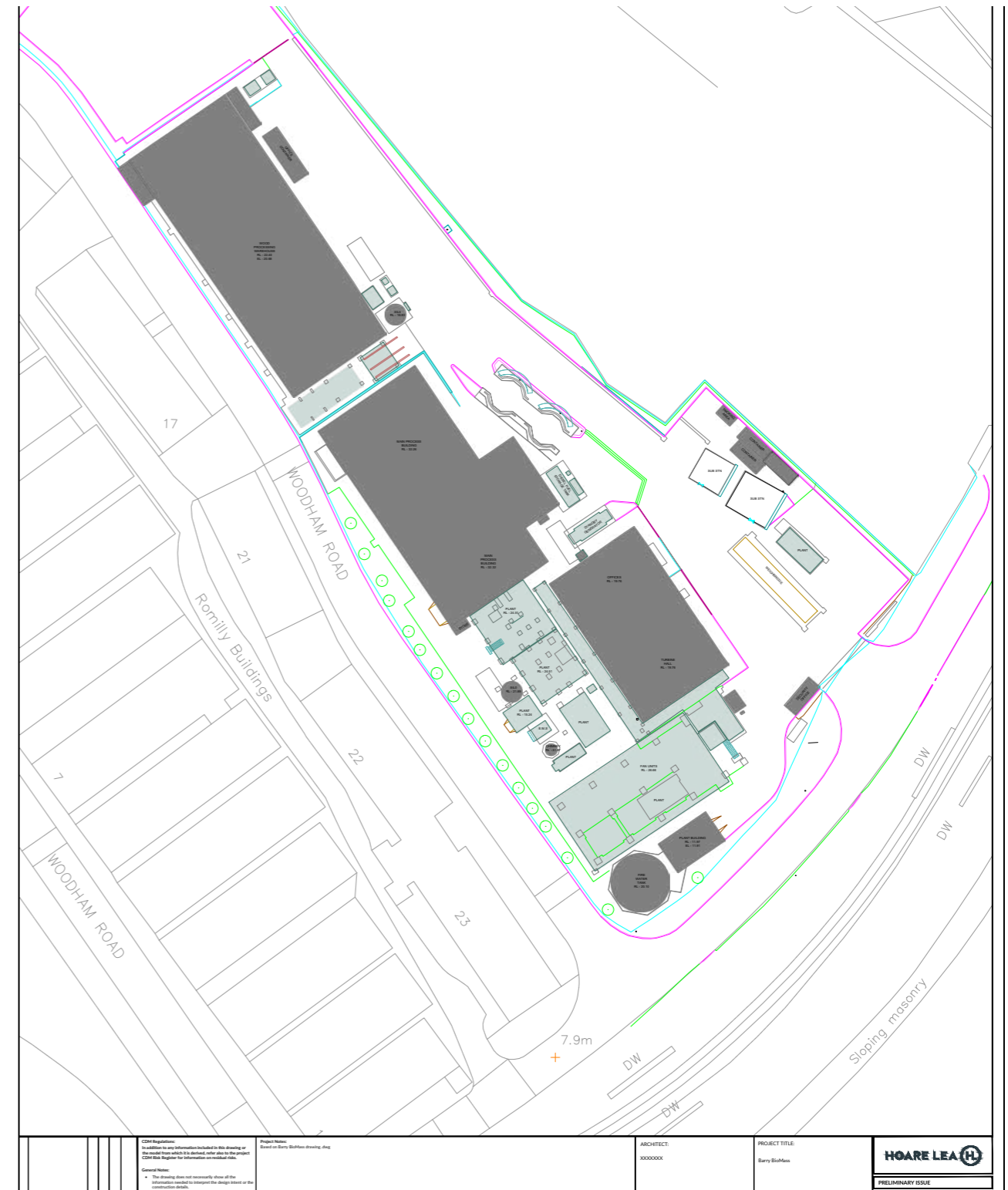


Figure 1.1 Topographical site survey - SLR

1.0 Introduction.

Assessment Criteria for the Completed Development

The planning application seeks planning permission for Barry Biomass Plant No.2.

For the purposes of demonstrating a robust assessment, the following standard industry precautionary measures are applied to the assessment calculation:

- It has been assumed that all relevant external lighting is operational simultaneously for the relevant pre or post curfew operational condition (i.e. a maximum adverse scenario).
- Small feature lighting, such as bench or uplights have been excluded from the assessment. The low output and orientation limit their impact.
- A unity Maintenance Factor (1.0) is applied to represent the maximum adverse condition from initial installation. This equates to "day one" lumen output of the luminaires, with no depreciation for luminaire cleaning.
- As per standard industry practice existing and proposed planting / trees have not been included within the assessment calculations. Physical mitigation such as solid fencing has been included in the calculation model.
- Ground surface reflectance has been taken as 22% based on data from CIBSE LG11: Surface Reflectance and Colour. This is an Area Weighted Reflectance based on typical sports surfaces & natural landscaping.
- The lighting design and subsequent plots should be based on lower than unity Maintenance Factor to reflect likely cleaning intervals and lumen depreciation. This will deliver the design-lighting levels in use and result in higher than design-lighting levels when new.

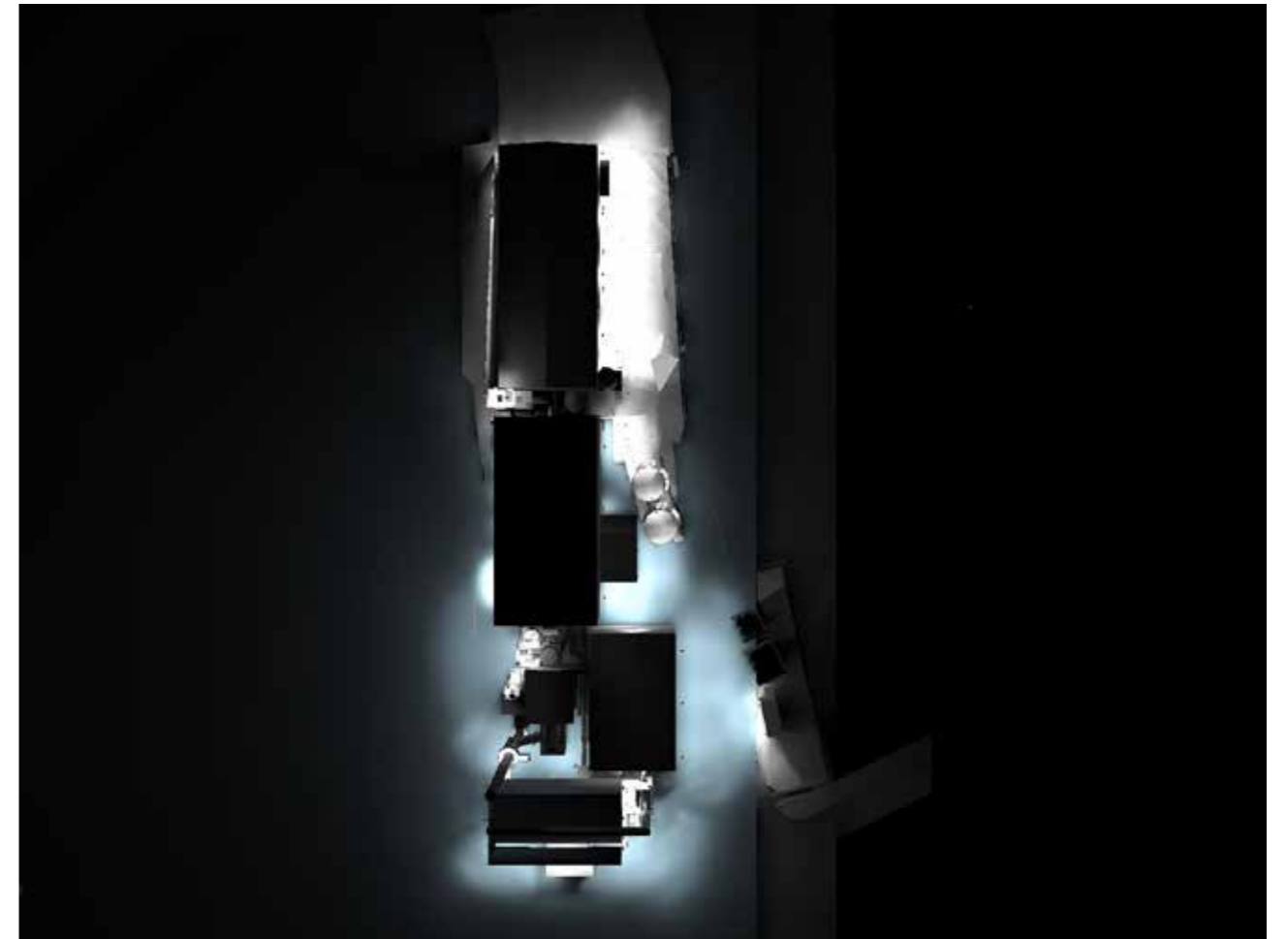


Figure 1.2 - Rendered site plan - aerial view.

1.0 Introduction.



Figure 1.3 - Lit impression of conveyor belt - west of site



Figure 1.4 - Lit impression of site plan - stairwells - west side.

2.0 Guidelines & legislation.

External realm lighting

A number of documents lay down the best practice and guidance on providing sufficient and appropriate lighting for vehicular thoroughfares, pedestrians passage and visual interest.

These are:

- BS 5489-1:2020, Design of road lighting.
- BS EN 13201-2:2015, Road lighting. Performance requirements.
- BS EN 12464-2:2014, Light and lighting - lighting of work places. Outdoor work places.

And if appropriate:

- CIBSE Lighting Guide 6: The Outdoor Environment 2016.
- CIBSE Lighting the Environment: A guide to good urban design.

It should be noted that where the scope line of the site ends, HL assume that the ambient lighting is sufficient and meets the required lighting criteria beyond the boundary line. It is not the responsibility of HL to provide the lighting for these areas.

Light pollution

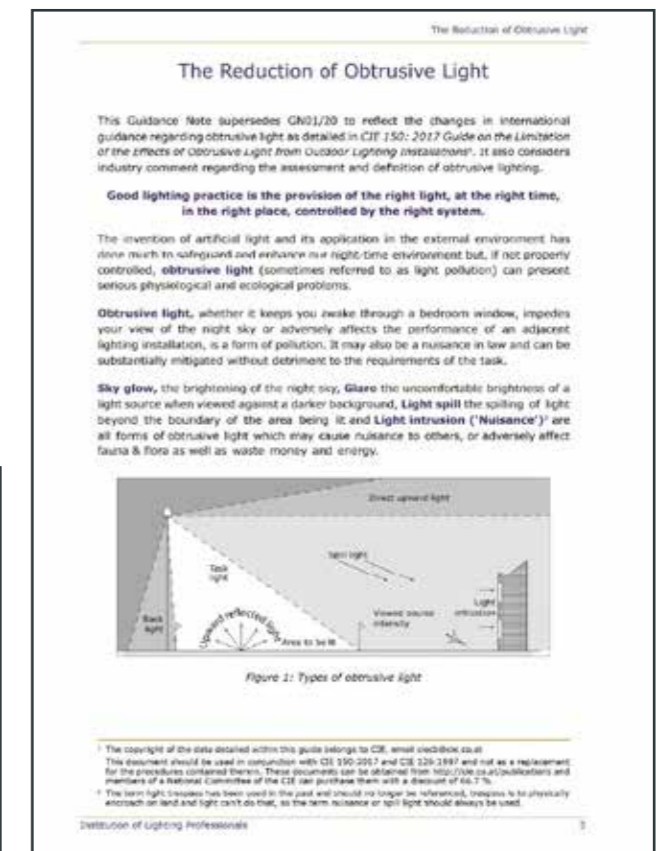
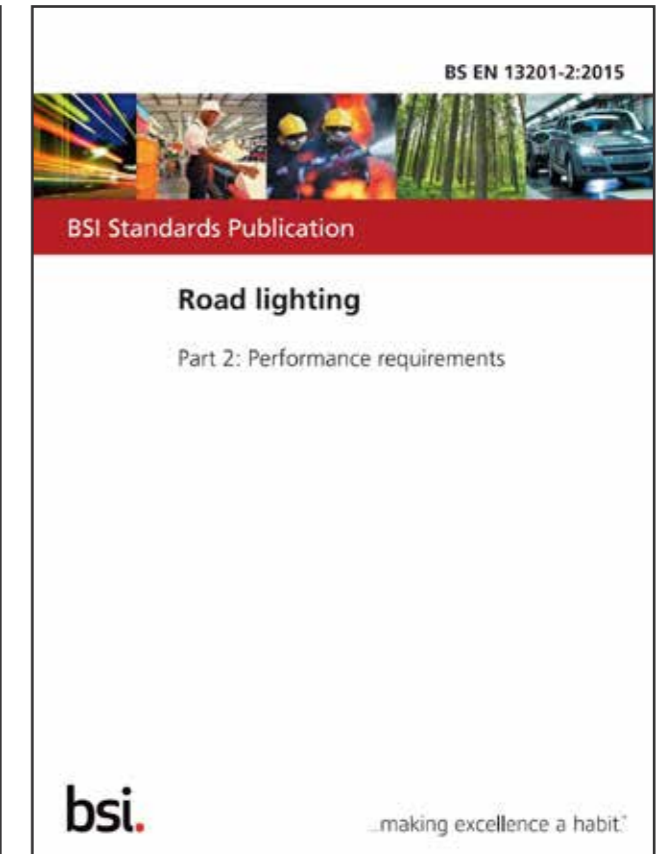
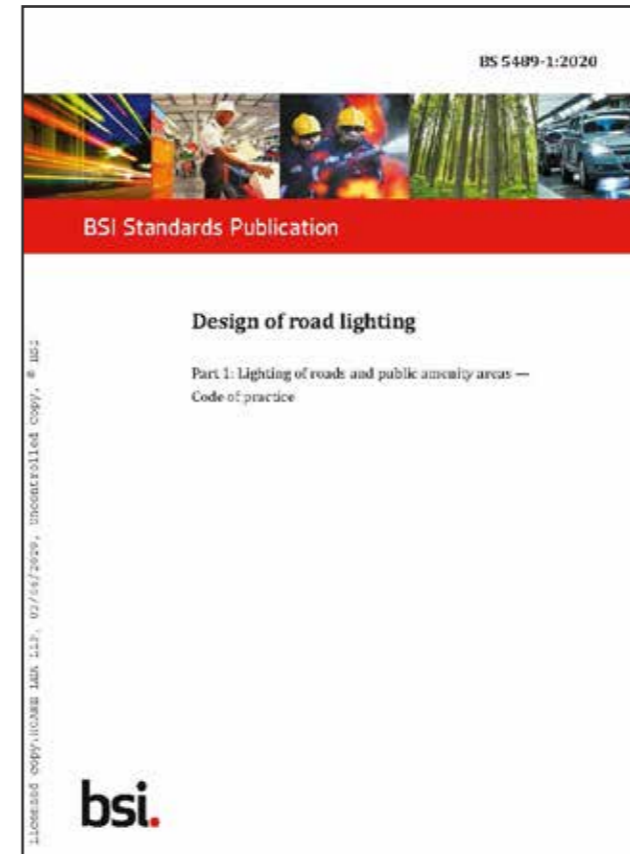
A number of documents lay down the best practice and guidance on reducing the visual and environmental impact of external lighting in relation to light pollution.

These are:

- CIE Technical Report - CIE 150: 2017
- ILP Guidance Notes for the Reduction of Obtrusive Light 2021

The implementation of these standards is vital because of "The Clean Neighbourhoods and Environment Act, 2005" which makes light a statutory nuisance.

It should be noted that, based on the current ecological conditions of the site and the proposed changes to the site, any lighting proposed to the site shall be considerate of any wildlife or potential new wildlife by ensuring that where possible light is directed into the site and any luminaires that are in close proximity to wildlife have good optical control and/or back spill shielding to minimize the impact on these areas.



2.0 Guidelines & legislation.

Legislation background

The issue of light pollution was introduced within the Clean Neighbourhoods and Environment Act (2005) as a form of statutory nuisance under the Environmental Protection Act (the 'EPA', 1990), which was amended in 2006 to include the following nuisance definition:

"(fb) artificial light emitted from premises so as to be prejudicial to health or nuisance."

Although light was described as having the potential to cause statutory nuisance (see also the Statutory Nuisance Statement (Document Ref. 5.9)), no prescriptive limits or rules were set for impact assessment purposes. Guidance Notes for the Reduction of Obtrusive Light produced by the Institute of Lighting Professionals (ILP) have, therefore, been referred to for the purposes of this document.

Guidance produced on Section 101 to Section 103 of the Clean Neighbourhoods and Environment Act 2005 has also been referred to, which places a duty on local authorities to ensure that their areas are checked periodically for existing and potential sources of statutory nuisances – including nuisances arising from artificial lighting. Local authorities must take reasonable steps to investigate complaints of such nuisances from artificial light. Once satisfied that a statutory nuisance exists or may occur or reoccur, local authorities must issue an abatement notice (in accordance with Section 80(2) of the EPA 1990), requiring that the nuisance cease or be abated within a set time-scale.

It is a requirement of the Conservation of Habitats and Species Regulations 2017 (as amended) ('the Habitats Regulations') that plans and projects are subject to an Appropriate Assessment if it is likely that they will lead to significant adverse effects on a Natural 2000 site (the collective name for European designated sites). Impacts from lighting are also relevant to the Habitats Regulations Assessment (HRA).

National planning policy framework

The National Planning Policy Framework (NPPF) Ministry of Housing, Communities and Local Government 2019 (MHCLG) states that the purpose of the planning system is to contribute to the achievement of sustainable development and constitute the Government's view on what sustainable development in England means in practice for the planning system. A principal concept contained within the NPPF is the presumption in favour of sustainable development and with regard to artificial lighting, the NPPF states:

"c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation."

Local planning policy

Light pollution is defined on Shared Regulatory Services website (partnership between Vale of Glamorgan Council and other Welsh councils) as '...any artificial light that is allowed to illuminate areas not intended to be lit.'



Ministry of Housing,
Communities &
Local Government

National Planning Policy Framework



Clean Neighbourhoods and
Environment Act 2005

3.0 Results.

Overview

1 - 60 – Residential (Horizontal) - Measured. 32, 34, 35, 36, 39, 42, 43, 45, 46, 50, 52, 55, 56, 57, 58, 59, 60 -calculated.

The data represented in **Table 1.4** and **Table 1.5** is relevant to identified residential locations where horizontal illuminance is the recognised key indicator.

1 - 60 – Residential (Vertical)- Measured. 32, 34, 35, 36, 39, 42, 43, 45, 46, 50, 52, 55, 56, 57, 58, 59, 60 -calculated.

The data represented in **Table 1.6** and **Table 1.7** is relevant to identified residential locations where vertical illuminance is the recognised key indicator.

V1 to V5 - Residential (Vertical) Calculated only

This data is represented in **Table 1.8** and is relevant to identified residential locations where vertical illuminance to windows (as opposed to horizontal illuminance) and luminaire source intensity are the recognised key indicators. Due to the nature of gaining access to private property only calculated values from the proposed site are shown.

Natural Receptor – Direct Sky Glow (SG1)

Direct sky glow is assessed as a site wide impact and is based on a scenario where the most onerous of lighting impact is applied relative to the potential uses within each area.

Calculated in accordance with CIE 150 (2003) Section 5.5.2 & ILP guidelines.

See page 12 for details.

Natural Receptor – Direct & Indirect Sky Glow (SG2)

Calculated in accordance with CIE 150 (2017). This is referred to as the Upward Flux Ratio (UFR).

See page 12 for details.



Figure 3.1 Aerial site plan with red line plan & hatched buildings

3.0 Results.



Figure 3.2 Image taken from Microsoft mapping - Showing off site survey points.

3.0 Results.

Tables 1.1 to 1.3 (inclusive) define the parameters for evaluating change to the site and surrounding areas. They define percentage rates of change from baseline and the sensitivity of receptors. These definitions are used in tables 1.4, 1.5, 1.6 & 1.7.

These tables are based upon the DMRB (Design Manual for Roads and Bridges). Document reference LA 104 - Environmental assessment and monitoring. Human receptors are assessed as low sensitivity and the magnitude of effect is defined by the change in value from the base line survey. The significance of effect is the product of these two afore mentioned criteria.

ILP guidelines provide limiting criteria for luminous source intensity (glare) and light intrusion to residential locations. Many of the positions assessed do not have a residence at that location, the purpose of assessment is to define the potential percentage increase in lighting levels in and around the development. This process forms the basis of assigning a lighting zone (as per ILP guidelines) to the area. These tables (1.4, 1.5, 1.6 & 1.7) only assess residential (human) receptors. However the data derived at these locations may be of use in ecology reports, where any discussion on significance will be clarified.

Defining Sensitivity of Receptor.	
Sensitivity	Definition
High	The receptor has little ability to absorb change in artificial light conditions without fundamentally altering its present character, or is of international or national importance.
Moderate	The receptor has moderate capacity to absorb change in artificial light conditions without significantly altering its present character, or is of high importance.
Low	The receptor is tolerant of change in artificial light conditions without detriment to its character, or is of low or local importance.

Table 1.1

Defining Magnitude of Effect.			
Magnitude of Effect	Horizontal and Vertical Light Trespass (Lux)	Direct Sky Glow ULR%	Glare Luminaire Source intensity
	Percentage Change Between Baseline Value and Baseline Value + Development	Percentage increase over guidance limits for the Environmental Zone (Baseline value not available).	Percentage increase over guidance limits for the Environmental Zone. (Baseline value not available).
High	75 to 100%	75 to 100%	75 to 100%
Medium	45 to 75%	45 to 75%	45 to 75%
Low	10 to 45%	10 to 45%	10 to 45%
Negligible	0 to 10%	0 to 10 %	0 to 10 %

Table 1.2

3.0 Results.

Assessing Significance of Effects			
Magnitude of Effect	Sensitivity		
	High	Moderate	Low
High	Major Adverse / Beneficial	Moderate Adverse / Beneficial	Moderate Adverse / Beneficial
Medium	Moderate Adverse / Beneficial	Moderate Adverse / Beneficial	Minor Adverse / Beneficial
Low	Moderate Adverse / Beneficial	Minor Adverse / Beneficial	Negligible
Negligible	Negligible	Negligible	Negligible

Table 1.3

3.0 Results.

Natural Receptor – Direct Sky Glow (SG1)

Sky glow is often seen above areas with high levels of illumination, it's typically the yellow/orange glow to the sky which can make viewing stars etc. more difficult. It can also have an ecological impact as it can disturb the natural cycles of wildlife. It is easiest to spot when viewing a city from a nearby darker area. Sky glow is produced by the light from poorly aimed or poorly designed luminaires being directed up into the sky rather than towards the ground where it can have a useful function. When developed, this area would likely be classified as E3 a figure of 5% of the total light used is allowable as direct upward light. The following shows the formula for calculating direct sky glow and demonstrating compliance.

Direct sky glow is assessed as a site wide impact and is based on a scenario where the most onerous of lighting impact is applied relative to the potential uses within each area.

In accordance with CIE 150 (2003) Section 5.5.2 & ILP guidelines the Upward Direct Light Ratio is calculated as follows:

$ULR = E_{up} / (E_{down} + E_{up})$

- E_{up} – Resultant average illuminance taken from a grid 1.0m above the highest luminaire
- E_{down} – Resultant average illuminance taken from a grid 1.0m below the lowest luminaire

For the purposes of direct sky glow assessment the majority of the site an surrounding area is currently considered to be representative environmental zone classification of an E4, Urban, High district brightness, Town/city centres with high levels of night-time activity.

In maintaining a no change / improved environment the ILP Guidance Notes for the Reduction of Obtrusive Light (2021) provides a limiting sky glow percentage of 15%.

$ULR = 0.08\%$.

Natural Receptor – Direct & Indirect Sky Glow (SG2)

In accordance with CIE 150 (2017) Section 6.4.3 the total upward light both direct & reflected can be calculated. This is referred to as the Upward Flux Ratio (UFR).

The whole site was calculated with an average lux level, based upon the variety of uses on site and weighted accordingly.

- Whole site. Average surface reflectance 22%, surrounding area surface reflectance 22%, average maintained illuminance required 50 lux. Maximum allowable UFR value allowable = 35. This is based on an amenity area in an E4 Zone.

The parameter plan lighting layout calculates a value of 8.94 which is within guidelines for the area.

3.0 Results - Adjacent to development - horizontal summary.

Sensitive receptor (human) - horizontal								
Survey location	Location name	Sensitivity	Environmental zone	Peak illuminance measurement (Lux) horizontal (H1) @ ground	Peak illuminance calculated (Lux) horizontal (H1) @ ground	Difference in peak illuminance from baseline condition at ground level	Note	Significance of effect
34	Woodham Road	Low	E1	0.25	0.01	- 0.24		Major Beneficial
35	Woodham Road	Low	E3	9.54	0.30	- 9.24		Major Beneficial
42	Woodham Road - in-between units	Low	E3	12.09	1.30	- 10.79		Major Beneficial
52	Woodham Road	Low	E3	2.06	4.50	+ 2.44		Moderate Adverse

Table 1.4

Legend to colour coding
Measured illumination (Taken from original baseline)
Calculated additional illumination (From modelled results)
Difference in peak illuminance from baseline condition at ground level

3.0 Results - Potential residential and transport - horizontal summary.

Sensitive receptor (human) - horizontal								
Survey location	Location name	Sensitivity	Environmental zone	Peak illuminance measurement (Lux) horizontal (H1) @ ground	Peak illuminance calculated (Lux) horizontal (H1) @ ground	Difference in peak illuminance from baseline condition at ground level	Note	Significance of effect
32	Ffordd Y Mileniwm	Low	E4	15.00	0.00	0.00		Negligible
36	Ffordd Y Mileniwm - Roundabout	Low	E4	20.00	0.00	0.00		Negligible
39	Council building/car park	Low	E3	8.10	0.00	0.00		Negligible
43	Woodham Road - front of units	Low	E1	0.37	0.00	0.00		Negligible
45	Council building/car park	Low	E3	7.30	0.00	0.00		Negligible
46	Council building/car park	Low	E4	19.71	0.00	0.00		Negligible
50	Cory Way	Low	E3	5.00	0.00	0.00		Negligible
55	Development site - adjacent to Cory Way	Low	E1	0.25	0.00	0.00		Negligible
56	Cory Way	Low	E3	5.00	0.00	0.00		Negligible
57	Development site - adjacent to Cory Way	Low	E1	0.25	0.00	0.00		Negligible
58	Atlantic Way	Low	E3	7.50	0.00	0.00		Negligible
59	Atlantic Way	Low	E3	7.50	0.00	0.00		Negligible
60	Atlantic Way	Low	E3	7.50	0.00	0.00		Negligible

Table 1.5

Legend to colour coding
Measured illumination (Taken from original baseline)
Calculated additional illumination (From modelled results)
Difference in peak illuminance from baseline condition at ground level

3.0 Results - Adjacent to development - vertical summary.

Sensitive receptor (human) - vertical								
Survey location	Location name	Sensitivity	Environmental zone	Peak illuminance measurement (Lux) vertical (V1) @ 1.5m AFFL (See baseline survey for direction)	Peak illuminance calculated (Lux) vertical (V1) @ 1.5m AFFL	Direction of Peak illuminance calculated (Lux) vertical (V1) @ 1.5m AFFL	Difference from baseline illuminance (Lux) vertical (V1) @ 1.5m AFFL	Significance of effect
34	Woodham Road	Low	E2	0.80	0.50	East	- 0.30	Minor Beneficial
35	Woodham Road	Low	E3	3.36	9.10	East	+ 5.74	Moderate Adverse
42	Woodham Road - in-between units	Low	E4	10.42	6.90	East	- 3.52	Minor Beneficial
52	Woodham Road	Low	E4	5.07	11.80	East	+ 6.73	Moderate Adverse

Table 1.6

Legend to colour coding
Measured illumination (Taken from original baseline)
Calculated additional illumination (From modelled results)
Difference in peak illuminance from baseline condition at 1.5m above ground level

3.0 Results - Potential residential and transport - vertical summary.

Sensitive receptor (human) - vertical								
Survey location	Location name	Sensitivity	Environmental zone	Peak illuminance measurement (Lux) vertical (V1) @ 1.5m AFFL (See baseline survey for direction)	Peak illuminance calculated (Lux) vertical (V1) @ 1.5m AFFL	Direction of Peak illuminance calculated (Lux) vertical (V1) @ 1.5m AFFL	Difference from baseline illuminance (Lux) vertical (V1) @ 1.5m AFFL	Significance of effect
32	Ffordd Y Mileniwm	Low	E3	7.50	0.20	East	+ 0.20	Negligible
36	Ffordd Y Mileniwm - Roundabout	Low	E3	10.00	0.20	East	+ 0.20	Negligible
39	Council building/car park	Low	E3	5.11	0.10	East	+ 0.10	Negligible
43	Woodham Road - front of units	Low	E2	1.17	0.00	East	0.00	Negligible
45	Council building/car park	Low	E3	7.38	0.10	East	+ 0.10	Negligible
46	Council building/car park	Low	E4	26.80	0.10	East	+ 0.10	Negligible
50	Cory Way	Low	E2	2.50	0.30	East	+ 0.30	Negligible
55	Development site - adjacent to Cory Way	Low	E1	0.25	0.10	East	+ 0.10	Negligible
56	Cory Way	Low	E2	2.50	0.00	East	0.00	Negligible
57	Development site - adjacent to Cory Way	Low	E1	0.25	0.08	East	+ 0.08	Negligible
58	Atlantic Way	Low	E3	3.75	0.06	East	+ 0.06	Negligible
59	Atlantic Way	Low	E3	3.75	0.07	East	+ 0.07	Negligible
60	Atlantic Way	Low	E3	3.75	0.05	East	+ 0.05	Negligible

Table 1.7

Legend to colour coding

Measured illumination (Taken from original baseline)

Calculated additional illumination (From modelled results)

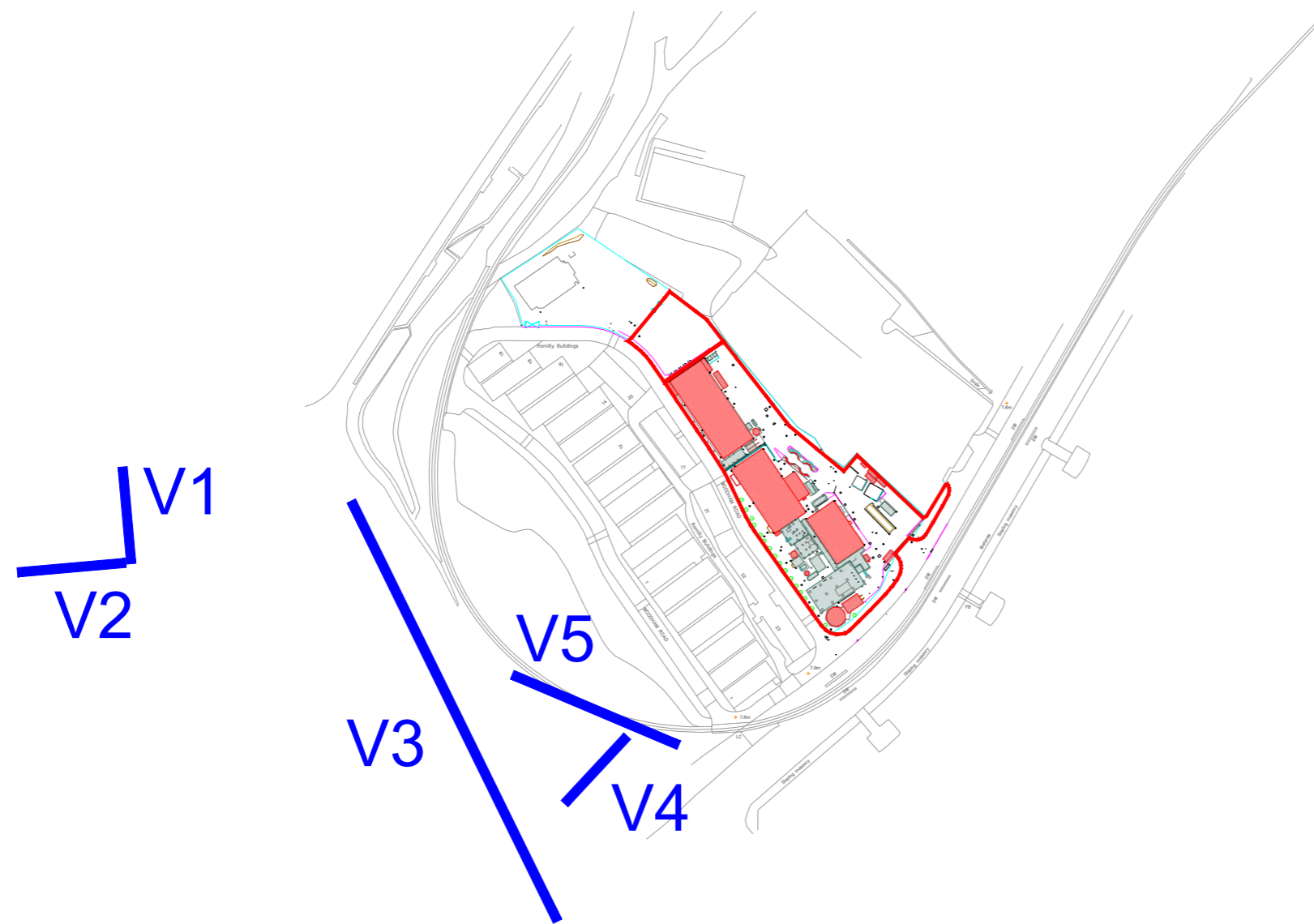
Difference in peak illuminance from baseline condition at 1.5m above ground level

3.0 Results - potential residential locations.

Residential vertical calculation surfaces.

Some areas on site are not practical to survey to obtain a baseline level to measure any potential impact from a development. In these situations virtual calculation surfaces are placed at the locations of existing and proposed residential properties.

The measuring surface will extend along the length of a known property and calculate values from ground level to 10m high. This methodology ensures any windows along the property can be assessed for potential impact from obtrusive light and glare (luminous source intensity).



Residential surfaces and orientation.	
V1	Potential residential - facing east.
V2	Potential residential - facing south.
V3	Potential residential - facing east
V4	Potential residential - facing north
V5	Potential residential - facing east

Figure 3.3 Image taken from drawing supplied - Showing vertical residential calculation surfaces.

3.0 Results - potential residential locations.

Sensitive receptor (human) - vertical (ILP Guidance notes 2021)				Light intrusion			Glare (Luminous source intensity)
Survey location	Location name	Sensitivity	Current Environmental zone	Vertical illuminance Max. into windows (ILP guidance notes 2011 & 2021) (Lux). Pre curfew	Calculated Max. vertical illuminance (Lux) (maximum value to elevation) *1	Compliant with ILP guidelines for noted zone. (Residential) *1	Compliant with ILP guidelines for noted zone. (Residential)*1 *2
V1	Potential residential - facing east.	Low	E3	10 Lux	0.10 Lux	Pass	Pass
V2	Potential residential - facing south.	Low	E3	10 Lux	0.00 Lux	Pass	Pass
V3	Potential residential - facing east.	Low	E2	5 Lux	0.10 Lux	Pass	Pass
V4	Potential residential - facing north.	Low	E2	5 Lux	0.00 Lux	Pass	Pass
V5	Potential residential - facing east.	Low	E2	5 Lux	0.40 Lux	Pass	Pass
<p>*1) These calculated values and pass/fail notations are based on a virtual surface 10m high, length as shown in Figure 3.3.</p>							
<p>*2) Glare, Maximum allowable value calculated is from CIE 150:2017 referenced in ILP Guidance Note 01/21 - Table 4. The allowable value varies by Projected Area (sq.m.) and Distance Factor. This parameter plan design demonstrates compliance with these guidelines. Note: Glare, Maximum allowable value calculated from CIE 150:2017 referenced in ILP Guidance Note 01/21 - Table 4. (varies by Projected Area sq.m. and Distance Factor).</p>							
<p>Table 1.8</p>							

3.0 Results - building luminance.

Building Luminance

From CIE150: 2017 (cross referenced in ILP guidelines)

Table 2 - Obtrusive Light Limitations for Exterior Lighting Installations- General Observers	
Environmental Zone	Building Luminance Pre-curfew
	Average L (cd/m²)
E0	<0.1
E1	<0.1
E2	5
E3	10
E4	25

Based upon an average building surface reflectance of 50% the building can achieve an average luminance in candelas per square metre (Cd/m²) within the guidelines for an E4 zone.

A sample calculation was performed on the western frontage of the most northern block, which showed an average value of 0.52 Cd/m².

3.0 Results - isoline of 0.5 lux horizontal (ground level).

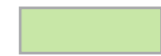


Figure 3.4. Image taken from drawing supplied - Showing 0.5 lux Isoline horizontal light levels at ground level.

4.0 Baseline site and environmental zone classification.

To assess the site we refer to the ILP guidance notes for the reduction of obtrusive light (2021) and CIE150.

In Figure 6 (adjacent map) areas would be classified as:



- **E2 Rural, Low district brightness (SQM ~ 15 to 20). Sparsely inhabited rural areas, village or relatively dark outer suburban locations.**

The areas with green colour fill would be classified as E2. These small pockets of land have no or very few artificial light sources within the immediate vicinity. At locations closer to the existing commercial centres, there will be higher levels of illumination it is likely that there will be either a direct view of light fittings or a view of the lighting impact. The areas are predominately disused brown field sites or open water.



- **E3 Suburban, Medium district brightness, Well inhabited rural and urban settlements, small town centres of suburban locations.**

Residential areas around the application site are lit to a level which fits the above categorization. The type of light fittings, spacings between luminaires coupled with the type of road and traffic density would in our professional judgement lead to this conclusion. There are small pockets of landscaped green space where horizontal light levels would be in line with an E2 category, however vertical levels of illumination, sky glow and the presence of light on all horizons would place those areas in a higher classification.

While many of the survey locations around the immediate site suggest an E1 categorisation the visibility of light sources in all directions and the poor sky quality measured a higher class of E3 is more appropriate.



- **E4 Urban, High district brightness, Town/city centres with high levels of night-time activity.**

The commercial areas within the map (including the application site) have a mixture of illumination sources, both column and building mounted. Column heights for light fittings vary between 8 and 14m with the highest light levels recorded near some of the loading bays in the facility. The lighting uniformity suffers from poor uniformity in some locations, however the light spill off the site to adjacent areas is well controlled.

Notably the amount of spill light on adjacent horizontal areas such as the trailer park and Woodham Rd was well controlled. Further afield due to the tilted aiming angle of the building mounted floodlights there was a noticeable amount of luminous source intensity (glare) which was visible.

The average light levels recorded in this area will place the application site in an E4 category. The type of luminaires, visibility from adjacent areas, height & positioning support this conclusion.

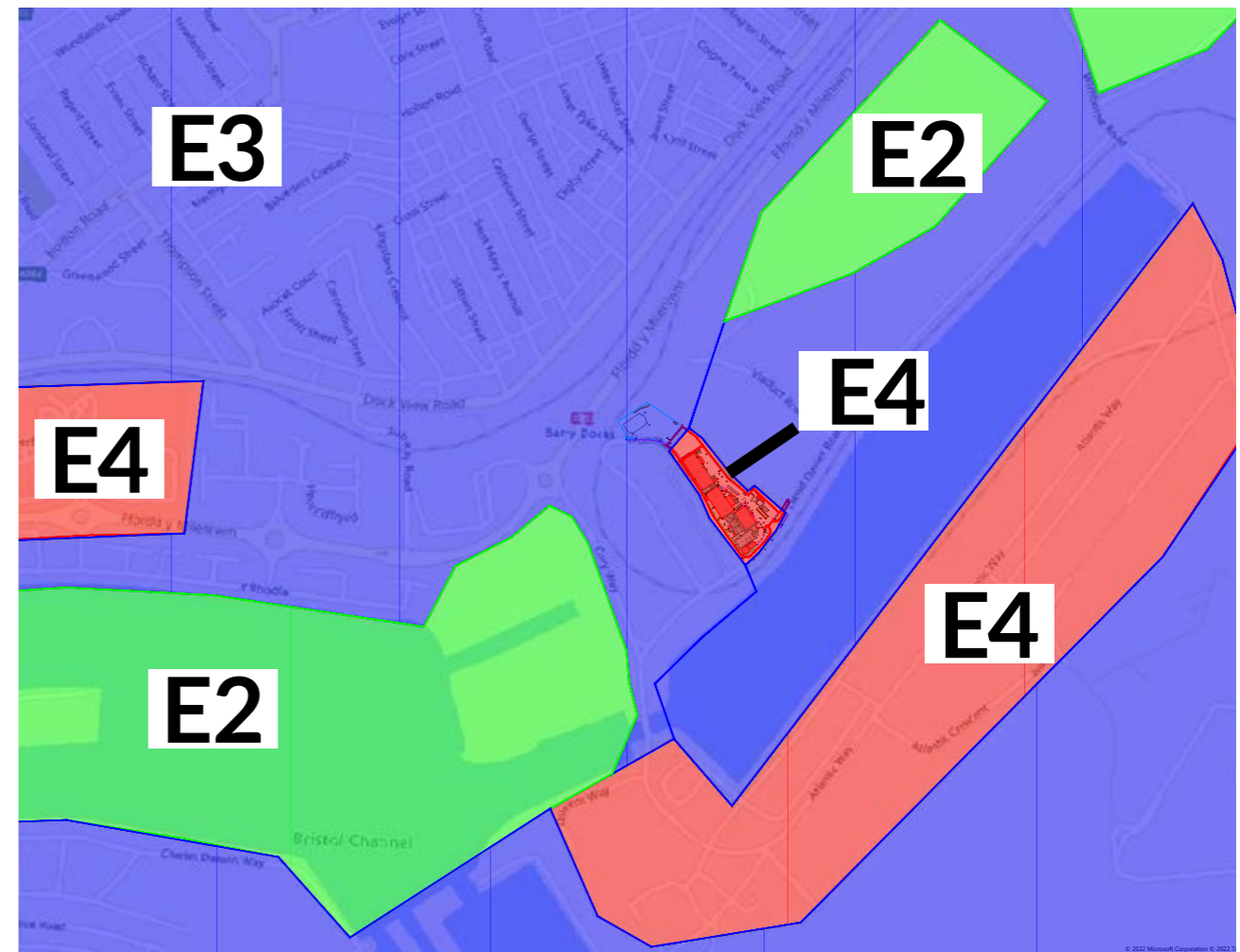
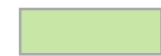


Figure 4.1 Map showing environmental lighting zones - Approximate red line of site shown.

5.0 Projected environmental zone classification.

Referring to the ILP guidance notes for the reduction of obtrusive light (2021) and CIE150, we have not identified lighting level changes at the site and surrounding areas that would warrant any modification of the level of environmental zones.

In Figure 6 (adjacent map) areas would be classified as:



- **E2 Rural, Low district brightness (SQM ~ 15 to 20). Sparsely inhabited rural areas, village or relatively dark outer suburban locations.**

The areas with green colour fill would be classified as E2. These small pockets of land have no or very few artificial light sources within the immediate vicinity. At locations closer to the existing commercial centres, there will be higher levels of illumination it is likely that there will be either a direct view of light fittings or a view of the lighting impact. The areas are predominately disused brown field sites or open water.



- **E3 Suburban, Medium district brightness, Well inhabited rural and urban settlements, small town centres of suburban locations.**

Residential areas around the application site are lit to a level which fits the above categorization. The type of light fittings, spacings between luminaires coupled with the type of road and traffic density would in our professional judgement lead to this conclusion. There are small pockets of landscaped green space where horizontal light levels would be in line with an E2 category, however vertical levels of illumination, sky glow and the presence of light on all horizons would place those areas in a higher classification.

While many of the survey locations around the immediate site suggest an E1 categorisation the visibility of light sources in all directions and the poor sky quality measured a higher class of E3 is more appropriate.



- **E4 Urban, High district brightness, Town/city centres with high levels of night-time activity.**

The commercial areas within the map (including the application site) have a mixture of illumination sources, both column and building mounted. Column heights for light fittings vary between 8 and 14m with the highest light levels recorded near some of the loading bays in the facility. The lighting uniformity suffers from poor uniformity in some locations, however the light spill off the site to adjacent areas is well controlled.

Notably the amount of spill light on adjacent horizontal areas such as the trailer park and Woodham Rd was well controlled. Further afield due to the tilted aiming angle of the building mounted floodlights there was a noticeable amount of luminous source intensity (glare) which was visible.

The average light levels recorded in this area will place the application site in an E4 category. The type of luminaires, visibility from adjacent areas, height & positioning support this conclusion.

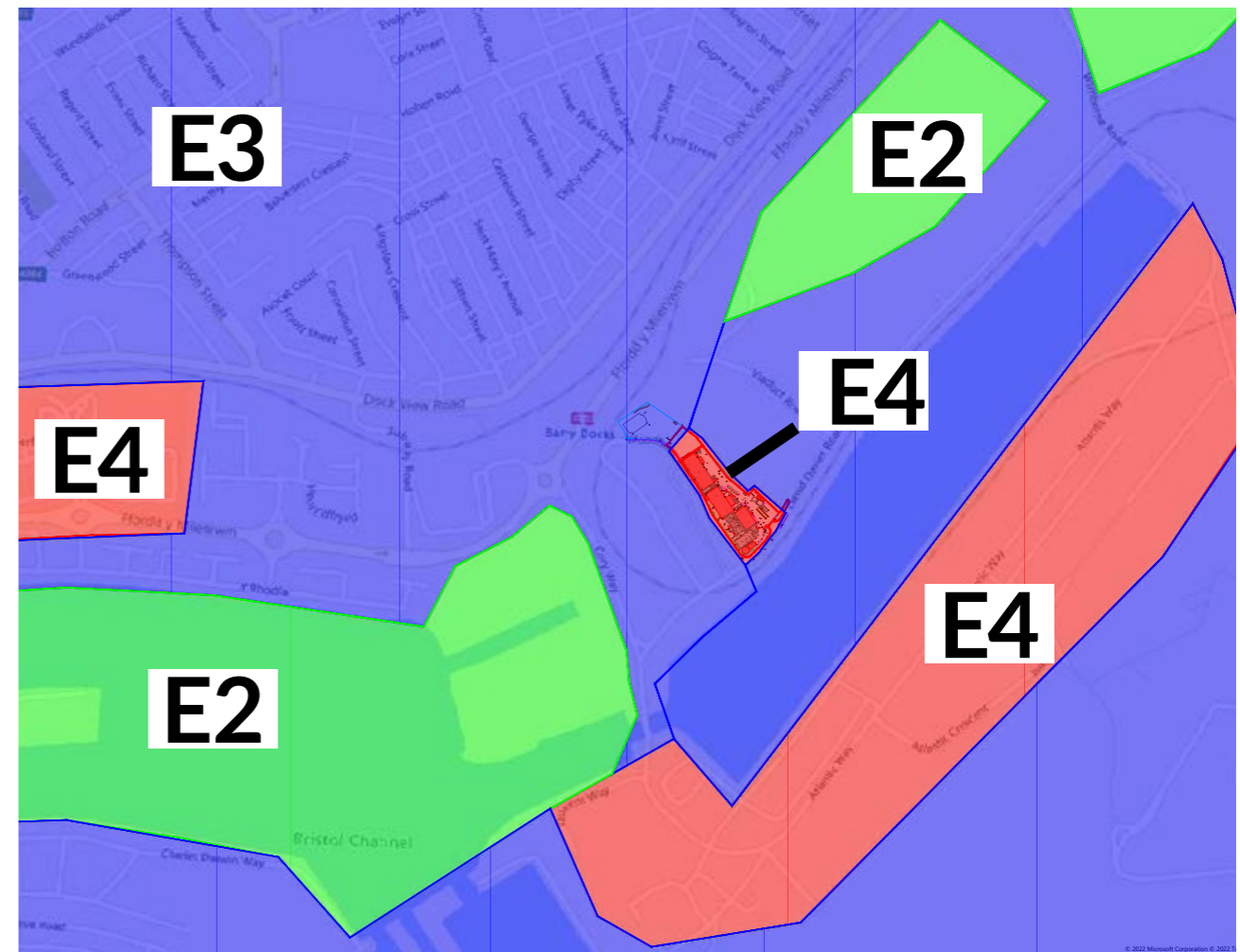


Figure 4.1 Map showing environmental lighting zones - Approximate red line of site shown.

6.0 Conclusion.

The impact of the lighting from the site has been summarised in Tables 1.4 to 1.8 and Table 2, only positions in residential or transport locations that may be impacted by the development were included. These were further categorized into two sub sections, A) Adjacent to site & B) Potential residential and transport. Horizontal and vertical lighting levels were analysed and the significance of effect noted. Negligible significance of effect is excluded from the summary and only adverse or beneficial significance noted.

Table 1.4 (Results - Adjacent to development - horizontal summary)

Horizontal positions 34,35 & 42 show a drop in spill light levels from the baseline condition. Position 52 did show an adverse result, however the position is very close to the site and the resultant value is well within guidelines for this type of environment.

Table 1.5 (Results - Potential residential and transport - horizontal summary)

All positions show a negligible significance of effect.

Table 1.6 (Results - Adjacent to development - vertical summary)

Horizontal positions 34 & 42 show a drop in spill light levels from the baseline condition. Positions 35 & 52 did show an adverse result, however these positions are very close to the site and the resultant value is well within guidelines for this type of environment.

Table 1.7 (Potential residential and transport - vertical summary)

All positions show a negligible significance of effect.

Table 1.8 (Results - potential residential locations)

All locations assessed represent the locations of windows in areas which may be developed for residential purposes. The calculations demonstrate compliance with the guidelines for both light into windows and the viewable glare of fittings located within the development.

Table 2 (Obtrusive Light Limitations for Exterior Lighting Installations- General Observers)

A value of building luminance (brightness) is allowed depending upon the environmental zone in which the building is located. A sample calculation was performed on a sample section facing west and the results were well within the ILP guidelines.

From the results collated it can be demonstrated that the resultant values will be well within the guidelines for obtrusive light as referenced in the Institution of Lighting Professionals (ILP) Guidance Note GN01/21. Potential residential locations to the east will not be adversely impacted by the development of the sit.



Figure 3.2 showing survey locations.

7.0 Glossary of terms.

- AONB, Areas of Outstanding Natural Beauty.
- Candela, (cd) is the base unit of luminous intensity in the International System of Units (SI); that is, luminous power per unit solid angle emitted by a point light source in a particular direction.
- CIE, Commission Internationale de l'Eclairage (International Commission on Illumination).
- Direct Sky glow: the direct upward spill of light into the sky, which can cause a glowing effect and is often seen above cities when viewed from a dark area.
- Glare: (viewed source intensity) the uncomfortable brightness of the light source against a dark background which results in dazzling the observer, which may cause nuisance to residents and a hazard to road users.
- IDA, International Dark-Sky Association.
- Illuminance, is calculated as the density of lumen's per unit area and is expressed using lux (lumen's/square meter). Illuminance can be measured using a light meter.
- ILP, Institution of Lighting Professionals.
- Light trespass/intrusion (vertical and horizontal): the spilling of light beyond the boundary of a property, which may cause nuisance to others.
- Lumen's, a measure of the quantity of light, referred to as luminous flux or just flux, emitted by a light source. For example, a 60-watt incandescent bulb provides about 840 lumen's.
- Luminance is a photometric measure of the luminous intensity per unit area of light travelling in a given direction. It describes the amount of light that passes through, is emitted or reflected from a particular area, In basic terms it would often be referred to as the "brightness" of an object typically when viewed against a dark background. This can be measured using a light meter but is more often calculated.
- Lux, is the SI derived unit of illuminance and luminous emittance, measuring luminous flux per unit area. It is equal to one lumen per square metre.
- Maintenance factor, usually a percentage is allowed for in lighting calculations to allow for the effects of time on fittings and their surroundings. Light sources, drop in output, fittings and surroundings become dirtier, several factors combine to reduce the amount of light available. A typical maintenance factor would be 70% this would ensure an installation was still meeting required light levels in for example 3 years. For this report a factor of 100% (unity) has been used, that is a day one, worst case scenario.
- Receptors, ecological, human, heritage, natural. These define positions around a site which may be impacted. Different receptors have various degrees of tolerance to increased light levels. For example an additional 10 lux in an already highly lit area (E4) could be described as negligible, whereas 0.5 lux to an ecological receptor in an intrinsically dark area (E1) could be described as major/adverse.
- Spill light: the unwanted spillage of light onto adjacent areas and may affect sensitive receptors, particularly residential properties and ecological sites.
- ULR, Upward Light Ratio. Expressed as a percentage of upward light compared to downward light.
- UNESCO, United Nations Educational, Scientific and Cultural Organization.



SEAN KIELTHY

PRINCIPAL DESIGNER/ENVIRONMENTAL LIGHTING

01454 806807
SEANKIELTHY@HOARELEA.COM

HOARELEA.COM

155 Aztec West
Almondsbury
Bristol
BS32 4UB

